Agriculture
Canada

Feeding and managing livestock during a feed shortage

Canada

Feeding and managing livestock during a feed shortage

J.E. Knipfel, G. Grigat and S.E. Beacom

Publication 5231

Cat. No. A63-5231/1984E ISBN: 0-662-13450-8
Printed 1980 Revised 1984 46M-9:84

CONTENTS

INTRODUCTION

This publication revises and updates available information that was summarized in the previous edition of *Feeding and Managing Livestock During a Feed Shortage*, published by Agriculture Canada in 1980. Considerable reorganization of the material has occurred as well as expansion of a number of areas in which new knowledge has become available. Increased efficiency in the use of common feeds and by-products for feeding will have general application in ruminant production under any conditions and in periods of severe feed shortages will be vital to the maintenance of producer flocks and herds.

The publication gives procedures for combining various sources of feed, processing and supplementation of by-products such as cereal crop residues, and possibilities for maintaining animals on a severely depleted pasture base.

Complementary management techniques such as pregnancy diagnosis, early weaning, supplementation of pastures and the use of stubble fields are described.

In addition, you are advised to seek assistance from animal scientists at Agriculture Canada research stations, provincial department of agriculture personnel, provincial feed-testing services, universities, and a variety of industry sources (feed companies, private consultants, and producer organizations).

ESTABLISH THE QUANTITY AND QUALITY OF FEEDS AVAILABLE

The first step in planning a winter feeding program is to take stock of resources (feeds, bedding, water) available on the farm, so that decisions can be made whether to cull stock to the extent of available feed, to obtain additional resources, or to alter feeding practices.

Pregnant beef cows or heifers will require, on the average, about 20 to 22 lb of conventional forage-based diet per day, although this can be lowered considerably by inclusion of other feeds such as grain or other more concentrated feeds.

Remember that the amount of digestible energy and protein consumed per day is the important factor, rather than the absolute quantity of feed.

Record the amounts of available forages, grain, and other feeds in a manner similar to that shown in the "Example Feed Inventory Sheet". As further information on dry matter and nutrient content of the feeds becomes available the sheet can be completed.

How much dry matter?

Since moisture content of feeds varies considerably, it would be advisable to determine moisture content so that the amount of dry matter actually available in the different feeds will be known. This is particularly important for silages.

Dry matter of feeds can be determined on the farm using either a conventional or microwave oven, and a scale capable of weighing reasonably accurately to 100 g. If using the kitchen oven, place 100 g of material on a cookie sheet or cake pan and spread evenly. Dry at 80°C (200°F) for 8 hours, let cool and weigh, replace in oven and reweigh at 2-hour intervals until loss in weight becomes negligible.

If a microwave oven is available, place 100 g of feed in the bottom of a paper bag which has been cut to leave a 2- to 3-in. side. Set at "high" and dry for 4 minutes. Remove, stir and replace for 1 to 2 minutes. Weigh after it cools. If high moisture material such as silage is involved, another 1-2 minutes drying period should be used. Remove, cool and weigh.

The weight of dry material remaining (grams) equals the percent of dry matter.

How much nutrient?

Because there will be considerable variation in feed quality and nutrient supplementation will likely be required for properly balanced diets, you have to know the nutrient content of available feeds. Representative samples of the individual feeds available should be forwarded to the nearest feed-testing laboratory for analysis. In several instances specific analysis may be required.

EXAMPLE FEED INVENTORY SHEET

Feed	Estimated amount	D.M. (%)	D.M. (pounds)	Crude protein (%)	Crude protein (pounds)
Barley	2 000 bu at 46 lb	88	80 960	12.5	10 120
Br-alf hay	1 500 bales at 50 lb	85	63 750	14.0	8 925
Oat silage	40 000 cu ft at 40 lb	36	576 000	11.5	66 240
Oat hay	2 000 bales at 40 lb	87	69 600	12.0	8 352
Barley straw	100 round bales at 800 lb	90	72 000	3.5	2 520
Wheat straw (feed and/or bedding)	500 round bales at 850 lb	90	382 500	3.0	11 475
Total					107 632

NOTE: In cereal hays whose growth has been arrested by drought or frost a nitrate analysis should be undertaken. For practical purposes protein and digestible energy (TDN) content are essential. Other essential nutrients including minerals and vitamins can be economically supplemented. Of particular concern is the provision of vitamin A and phosphorus.

Water

Quantity and quality of water supply is particularly important in a dry year. Excessive evaporation and algae growth can seriously affect quality. If in doubt, have water analyzed; contact the lab for containers.

The amount of water consumed by livestock depends on kind and amount of diet (increasing as level of protein, mineral and dry matter intake increases), temperature of the air and water, quality of the water, kind and size of the animal, level of production and availability of water. Restricting water intake will reduce intake and efficiency of feed utilization and could lead to rumen impaction where large amounts of low-quality roughage are being fed. It may also lead to the development of urinary calculii (water belly) under some conditions.

Poor-quality water can cause problems ranging from death to impaired animal performance. Nitrate levels of 0.35% are toxic to cattle. The presence of alkali salts can interfere with mineral nutrition. Water containing more than 5000 ppm of solids is inferior, especially for younger stock. Where algae are plentiful (as is often the case in a dry year), the water can be poisonous to livestock. Sloughs, dugouts and ponds can be treated with bluestone to control algae. Apply at the rate of 1 lb for 16 000 cu ft of water. Place bluestone in a water-permeable bag, tie baling twine or light rope to each end of bag and work back and forth throughout dugout to assure even treatment. Measure dugout and bluestone carefully. Excessive bluestone can be injurious to stock.

The table below shows average water requirements for livestock. When assessing water supply be sure to allow for expected losses due to evaporation, seepage and freezing. If there is any likelihood of running short, take steps immediately to obtain more (Some provincial governments have programs to help farmers pump water to dugouts).

Points to remember

—Keep water troughs clean.

—Allow free access to water at all times, or water frequently.

—Heat water in winter to 4 to 5°C (40°F) to prevent freezing and encourage consumption.

—Check water supply frequently (power failure, frozen line or stuck float could be important with automatic waterer—electric shorting out at the waterer can discourage or prevent consumption).

—Beef cows can use snow to meet water requirements but this should be considered only if water is not available.

MINIMIZE THE FEED REQUIREMENTS

Pregnancy testing and culling

It is essential to cull non-producing breeding stock. The average beef-calf crop in herds on the prairies appears to be about 70%. Thus, approximately 30% of beef cows in any one year produce no calf but consume feed, which is expensive and in short supply. If non-producing animals are eliminated from the breeding herd, the calf crop remains the same and the total amount of feed for cow wintering is reduced by almost one-third.

If herd reductions are required, they must be adequate to ensure that the remaining cows can be properly fed so that they can produce and wean a calf. Underestimation of the feed resources can result in loss of animals and therefore a loss of the feed that was put into the cow. By making the proper herd reductions early, more productive animals can be maintained through the winter.

If it is necessary to reduce the size of the herd to meet available feed supplies, the first choice for culling is those animals which are least likely to provide a return. The following list of criteria for culling may be used as a guide to herd reductions:

1 Strict culling of open cows and cows with udder, feet, leg, etc. problems. Although these animals are normally culled, strict adherence to these culling procedures can reduce the number of potentially unproductive animals.

Class of stock	Est. consumption, gal/day (1 gal = 10 lb)	
Dairy cow (milking)	35	depending on milk production
500 lb steer (maintenance)	6-8	depending on temperature
800 lb steer (finishing)	8-10	
1100 lb steer	10-15	
1100 lb pregnant beef cow	8-12	
Mature sheep, dry diet	0.5-1.0	varies with availability of snow, moisture content of feed and temperature
Lambs, 65 lb (ground dry diet)	0.5-1.0	
Sheep, lush pasture or silage	very little	

2 Cows with calving problems or any condition that substantially reduces their chances of producing and raising healthy calves to weaning should be removed from the herd.

3 If further reductions are necessary, consider reducing as much as possible the number of replacement heifer calves since they will not produce a calf in the spring. Reductions here have to be made with consideration for the future breeding herd since fewer replacements this year will mean additional replacement animals will be required within the following two or three years to maintain the breeding herd size.

4 Further herd reductions mean the removal of breeding herd animals. This again should be done on the basis of a cow's chances of producing a calf to weaning. Therefore, reductions should first be made on pregnant replacement heifers since the probability of calving problems reduces the chances of these animals weaning a calf. Again consider the numbers of these animals removed from the herd on the basis that additional replacement animals will be required in the following year or two.

5 The next group of animals to be culled will be those animals 10 years and older who are reaching the end of their productive life.

By taking this approach to herd reductions, the percentage of animals that produce a saleable calf can be maximized during a year when cash flows will be a problem.

Early weaning

Under most management systems on the prairies the growth rate of the calf is obtained at the expense of the cow after August, and is much lower than earlier in the grazing season. With early weaning the cow goes into the winter feeding period in better condition, thus providing insulation and energy reserves that result in lower winter feed requirements. Fall and winter pasture can also be extended, which will reduce the requirements for winter feeding. If the calves are retained after weaning, they will be over the weaning stress, reducing the likelihood of shipping fever and pneumonia once in the feedlot.

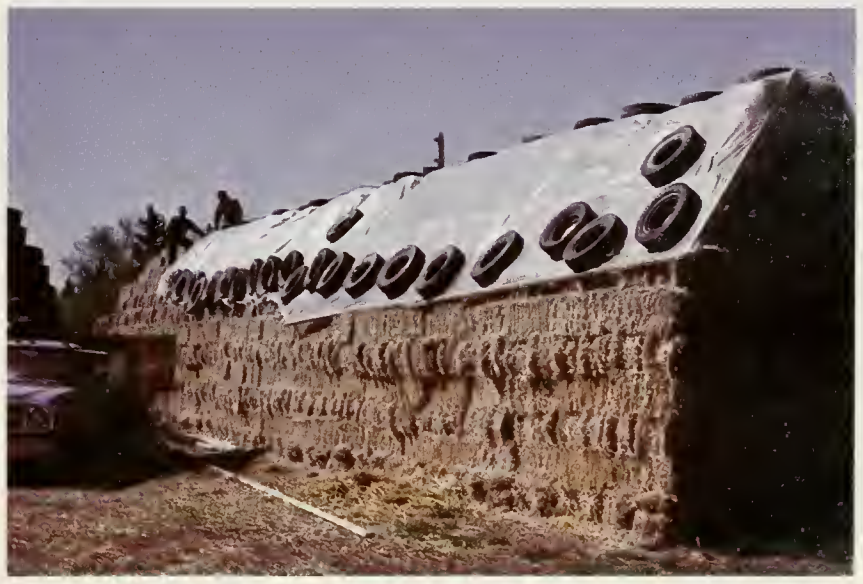
Weaning calves 2 to 3 weeks before freeze-up and placing them on pasture reduces stress normally caused by weaning and immediately placing on dry food. It also allows cows to improve in condition before going into the winter.

Protecting the feed supply

Large quantities of forage are lost each year as a result of poor storage procedures. Hay and straw harvested at moisture levels above 16% will lose nutrients due to heating and molding. The National Academy of Science suggests that hay that has been heat damaged (resulting in a brown color) has only 80% of the useful protein left. If heated to a black color only 50% of the useful protein is left.

Stacking wagons can produce reasonably weather-resistant "packages" of mechanically stacked hay, provided the operator can achieve a well-rounded, uniformly sloping top. Depressions on the top funnel rainfall and melting snow into the stack, causing spoilage.

Hay and straws are best stored in tightly packed stacks, preferably under cover. If haysheds are not available, tarpulins or plastic covers can provide worthwhile protection. Stack hay on well-drained areas to minimize spoilage of the bottom bales. Line stacks up in a north-south direction away from buildings and shelterbelts to permit best exposure to sunlight and wind to speed drying following a rain or snow-melt.



Protecting the straw supply. If straw is to be carried over into the next year or will be subjected to considerable precipitation it may pay to protect it with well-tied-down tarpaulin or plastic sheet. Be certain to cover it day after stacking.

Storing round bales. Though not recommended in high rainfall areas, "pyramid" storage does save space.

Moisture contents for silage will be critical, particularly during dry conditions. Silage should not be put up at over 79% moisture to reduce seepage losses. With moisture below 55%, heat damage is likely to occur although oxygen-limiting silos permit ensiling of drier material.

Dry matter losses are usually about 5-6% for oxygen-limiting silos, 8-10% for upright concrete silos, 10-15% for well-made horizontal silos and may be up to 25% for dug bunker silos. These figures may change dramatically from operation to operation, however, and it is possible to produce silage of high quality and low loss in horizontal and bunker silos. If the silo has been properly prepared (i.e., patch holes, etc.), the forage has been properly prepared and packed into the silo, and the silo has been properly sealed (plastic covers with bunker silos), you may substantially reduce feed losses.

Grains should be stored at a moisture content below 16% to ensure that the grain does not mold and heat. Properly sealed graineries will prevent moisture from entering and causing molding in corners or along the sides. Ensure that all openings are patched to prevent grain from leaking out.

Feeding practices

First, consider the feeds available and the additional feed which may be required. When making the choice of which feed to buy, the requirements of the animal and the number of animals to be fed must be determined. Once this has been established the next step is to determine the feed or feeds which will meet your needs at the lowest possible cost. These are not always the more traditional feeds such as hays or straws. Grain may provide the nutrients required by wintering cattle at the lowest possible price. Grain contains approximately 50% more energy than hay and about 100% more energy than straw on a weight basis. Therefore, if hay costs $100/ton and grain $125/ton, grain will provide the same amount of energy at a much lower cost than hay. Feed grains can safely provide 50% of the feed requirements of beef cows and heifers if the diets are managed properly.

It is obvious that free choice feeding of whole grain is not a realistic way of feeding wintering beef cattle. The first step to using feed grains is processing. Feed grains should be coarsely rolled. If the kernel is shattered or too finely rolled, digestive upset and bloat may result. Proper feed preparation will be essential to obtain the full benefit. See Agriculture Canada Publication 1591, *Feedlot Finishing of Cattle* on processing of grains.

The next step is to understand the animals' requirements for energy, protein, calcium, phosphorus and vitamin A and provide supplements that meet these requirements. If grain is a major component of the diet, the amount of grain fed must be limited. Since the animals are being limit fed, it is imperative to allow at least 0.7 m for each animal to allow all animals access to the feed bunk.

The final step is introduction of the animals to the feed. Cows unfamiliar with feed grains may either overconsume or, initially, refuse to eat. If animals are familiar with grains, no introductory period is required. Since the animals are being limit fed they cannot consume enough grain to cause digestive problems if the grain is properly prepared. If the animals are not familiar with the feed, an introductory period of about 1 week where a maximum of only 1 kg of grain per animal per day is fed. This will let the animals adjust to this new feed and prevent any animals from overconsuming.

Once the feeding program has been established, many other steps may be taken to reduce winter feeding costs. If feeding round or square bales on the ground, put out only as much as the cows will consume in 20-30 minutes to keep fouling and trampling to a minimum. Feeding on the ground can result in feed losses of up to 50%. Instead, feed in bunks or trough feeders.

Be sure that hay self-feeders are properly designed and managed to avoid wastage or bridging. If a feeding gate is used, it may be advisable to limit the amount of hay accessible at any one time so that all feed will be consumed and buildup of spoiled feed will be prevented. The high cost or scarcity of feed may justify the additional labor involved. Similarily, the amount of silage provided should

Self feeding straw to wintering beef cows. The use of electric fence and movable posts facilitates feeding with minimal wastage.

be controlled to prevent a carryover in the trough which could freeze or spoil.

For some producers, avoiding overfeeding may be as important as ensuring adequate nutrition. Cows carrying too much condition can have problems at calving time.

For procedures in formulating diets, refer to Agriculture Canada Publication 1670, *Feeding Beef Cows and Heifers*. This publication provides information on nutrient requirements of various classes of animals, nutrient contents of feeds and diet formulation procedures. Information on nutrient contents of feed samples and some information on nutrient requirements of beef cows and heifers may be found in Appendices 1 and 2 of this publication.

Environmental protection

Protection from wet and windy conditions during the winter can reduce the feed requirements of cattle and sheep. Depending on the condition of the animal, the production provided, and the severity of the winter, the feed savings can be 20% or more.

Providing well-ventilated sheds when wintering cows reduces feed and bedding requirements and permits early calving (with aid of infrared heaters to dry newborn calves).

The first step in providing proper environmental protection is to understand the requirements of the animal. The animal's major problem is to maintain body heat. There are two important effects when considering the effect of winter conditions. The first of these is the acute cold stress caused by a cold snap or blizzard. The second is a more general increase in the energy requirement of the animal and the acclimatization changes that occur in the cattle.

Relatively few winter days (20 to 50 days per winter) are cold enough to cause an acute cold stress. However, if the animal is in poor condition, it will not be able to rely on body fat reserves and will depend entirely on additional feed to provide the energy it requires. Animals in good condition will have insulation against weather that can cause stress. Animals in better condition can usually afford to lose some of the body condition during the cold periods.

Wintering beef cows with minimal shelter. A slatted fence, bedded mound, self-feeder for straw, feeding bunk for supplemental hay, silage, grain etc., and a calving shelter (with heat lamp) can provide adequate care at reasonable cost.

A major component of the effective temperature is the wind speed. For example, the effective air temperature in a 60 km/h wind when the ambient air temperature is 0°C is –31°C. Most animals will be cold stressed by this. It becomes obvious that some form of wind protection will reduce the additional energy costs due to acute cold stress.

Although full protection (i.e., full confinement of beef animals) of the animals against winter conditions is not practical in Western Canada, proper use of existing shelters or construction of inexpensive shelter is suggested. For information on the construction of animal shelters, use of windbreaks, and control of snow, refer to Agriculture Canada Publication 1461, *Snow and Wind Control for Farmstead and Feedlot*.

A slotted fence and well-bedded mound provides good protection from wind and wet ground, saving feed energy for production.

Bedding is required in most livestock operations except those with slatted floor facilities. Quantity required per head will depend on the kind of diet (more when high-forage rate than high grain diets are fed), drainage (slope and soil type), humidity, temperature, precipitation, kind of shelter, type of bedding and density of stocking. Commonly used bedding materials (pounds required to absorb 100 lbs of water) are wheat straw (45 lbs), oat straw (35

lbs), chopped straw (20-30 lbs),softwood shavings(25 lbs) and sawdust (25 lbs). The table below gives estimated bedding requirements in pounds per animal per day (tons per year assuming a 200-day winter period).

Herd health

Many management and environmental factors can create stress that lower the animal's resistance to disease. If possible, such operations as weaning and castrating should not be carried out simultaneously nor should they be done under adverse weather conditions. Proper facilities should be available to permit handling of livestock with minimal stress to both animal and man.

Livestock should be protected by following recommended vaccination procedures for blackleg, malignant edema and any other diseases prevalent in the area. Use sterile procedures to prevent infection in the animal. Parasites such as warbles and lice should be controlled by timely applications of the appropriate treatment, following recommended procedures.

When transporting cattle, provide adequate protection from the weather and cover the floor with sand to give the stock adequate footing.

When diet changes are planned, make gradual changes, particularly when increasing the grain allowance. Performance can be seriously affected when animals scour, bloat or go off feed. Watch closely for symptoms of bloat, impaction and diarrhea.

FEEDS AND HOW TO USE THEM

Pastures and range

In late summer and fall, when sufficient quantities of forage are available on range, there often is sufficient digestible energy content in the forage to support a pregnant cow that is not milking. Protein supplementation may frequently be required and supplementation with vitamin A and phosphorus is almost always required. Supplementation may be achieved through liquid or dry commercial supplements, supplement blocks, or grain or high quality forage. Several species of forages developed for improved pastures in the brown and dark brown soil zones show considerable value for late summer and fall pasture. Both crested wheatgrass and Russian wild ryegrass will exhibit regrowth if there is precipitation in late summer and this regrowth can supply high quality grazing well into the fall. Altai wild ryegrass produces high quality forage well into later stages of the grazing season and should be seriously considered for this role in any grazing system.

Cows grazing Altai wild ryegrass in late fall. Extending the grazing season cuts winter feed requirements.

In periods where feed shortages occur, however, the overall pasture forage supply will, in most cases, be inadequate; there will be an overall deficiency in digestible energy as well as protein, minerals and vitamins. The use of supplemental feeds such as grain, stored forage or commercial feeds (range pellets or cubes, alfalfa cubes) will be needed to provide a larger proportion of the animals' feed requirements. Extreme caution must be taken, especially on native range, to ensure that severe overgrazing does not occur, since this will reduce the productivity of the range for years afterwards. In addition, since native range does not begin growth early in spring, overgrazing will extend the feeding period following calving. This will be expensive and may also cause labor problems in spring when other operations on the farm are critical.

Judgement must be exercised in grazing perennial pasture and hay stands. Grazing newly established stands or established forage stands too closely will prevent build-

BEDDING REQUIREMENTS IN POUNDS PER ANIMAL PER DAY (TONS/YEAR)

	Manure pack loose housing	free stall loose housing	tie stall
Dairy cattle			
Milk cows	15(1.5)	4(0.4)	8(0.8)
Dry cows and heifers	8(0.8)	2(0.2)	4(0.4)
Calves	3(0.3)	1(0.1)	2(0.2)
Beef cattle			
Cows and bred heifers	4-8(0.4-0.8)		
Yearlings	3-6(0.3-0.6)		
500 lb calves	3-4(0.3-0.4)		

Late-seeded oats provide productive summer-fall pasture.

up of root reserves, cause winter killing and reduce subsequent production. In some areas the ability of pasture regrowth to hold snow can also affect winter survival and spring moisture supply, limiting forage available for spring grazing. The producer therefore must assess the advantages of perennial pasture grazing in fall in relation to the grazing situation next spring.

Cereal grain production areas

Stubble fields represent a potentially valuable late-season forage for beef cows and are widely used in many areas of the prairies. The forage supply and quality from stubble fields is extremely variable and frequently will require some supplementation with protein, minerals and vitamins.

Grazing cereal crop stubble reduces dependance on perennial pasture and stored feed.

In times of extensive drought there may be large areas of cereal crops that cannot be harvested for grain and which may represent a potentially valuable source of grazing. However, the availability of water and/or fencing may be a serious constraint to its use. Nitrate often accumulates to toxic levels following drought stress, so anyone contemplating grazing of cereal crops should test for nitrate levels. Oats are most susceptible to nitrate buildup but all cereal crops can be affected.

Standard rectangular straw bales are more convenient than large round bales when preparing complete ground rations or when bedding sheds and small pens. However, the smaller bale needs more labor to bale and stack.

Use of unrecoverable grain crops for grazing should be tempered with soil conservation practices. Leave enough material to trap snow and control erosion.

Opportunity feeds

Slough hays (sedges, red top, reed canarygrass) are usually coarse and relatively low in quality, because maturity is normally advanced before harvesting is possible. In dry years, however, it is possible to harvest slough grasses at an earlier stage of development when feed quality and physical characteristics compare well with that of other grass hays.

Slough hay, harvested at the right stage, can go a long way towards meeting the nutritional requirements of the wintering beef cow.

At any stage, slough grass is useful for feeding to livestock, particularly to wintering cows, and should be superior to mature cereal straw. If stemmy, it can be ground to encourage consumption without waste, but grinding is more difficult and requires more power than grinding alfalfa or bromegrass. Supplementation with protein and energy may be necessary and additional vitamin A and minerals will be required for any class of stock.

Much forage goes to waste annually along prairie roadways. Quality of roadside hay will depend on the species, contamination with weeds, when harvested and amount of weathering. Hazards include glass and metal debris that may get into bales; care should be exercised by both the hay maker and the feeder. Such debris can cause hardware disease and can also do considerable damage to processing equipment (see section on "Hardware disease").

Screenings consist of broken or shrunken seeds, particles of chaff, weed seeds, and other extraneous matter left over after the grain or seed is cleaned for market. Screenings are highly variable, ranging in value from that of the parent crop to that of straw or less. Because of this, it is important to have a representative sample of the lot being purchased analyzed, at least for crude protein content, and preferably for digestibility. If they are relatively free of soil and grit, weight per bushel is a convenient measure of feeding value compared to grain. Where screenings contain a significant amount of small weed seeds, it would be advisable to grind them. Otherwise they may pass through the digestive tract intact and pose a serious weed problem on manured land.

Screenings can be useful in diets for beef cattle and sheep. Unprocessed rapeseed screenings have been self-fed to finishing steers with good results, when obtained at a very low cost. Processing would lead to more efficient nutritional use. Some rapeseed screenings contain large amounts of wild oats.

Screenings from legumes such as alfalfa, clover, peas and fababeans can be high in protein and can be used as a protein supplement in ruminant diets if unit cost of protein compares favorably with that of rapeseed meal or dehydrated alfalfa meal, for example.

A number of species of common weeds (e.g., Kochia) have excellent nutritive value if harvested at appropriate stages of maturity, and have been used as beef cattle feed.

Perennial hays

Grass-legume hay of good quality is the forage of choice for dairy cows. It will more than meet the requirements of wintering beef cows and thus is usually fed as a supplement to low-quality forages or straw. It can be used to provide the nutritional requirements for growing steers and heifers when fed with 2-5 pounds of grain per head daily. Quality of grass-legume hays is determined by the stage of maturity at which the crop is cut, the amount of legume present and the extent of nutrient losses suffered during handling, storage, processing and feeding. If beef cattle producers are fortunate enough to have even a limited quantity of good-quality grass-legume or legume hay available, it can be most effectively used (in order of priority) to:

1 supplement a straw-grain based diet for breeding cows following calving;

2 provide a portion, 1/3 to 1/2, of the diet for growing replacement heifers; or

3 supplement a straw-grain based diet for pregnant cows.

Grass hays such as bromegrass or crested wheatgrass are generally of lower nutritional value than grass-legume hays and thus may not be as useful in supplementary roles. These grass hays may, however, make up a large proportion of the diet of the growing animal and in some cases be the entire diet of the mature animal with supplements of minerals and vitamin A added.

Green feed (cereal hays)

Cereal crops cut in the early dough stage and handled as a hay crop provide a very nutritious forage that can equal good-quality grass-legume hay in feeding value, particularly for beef cattle. At this stage the leaves and

When cereal crops are needed for pasture but fencing and water supply pose problems, they may be field chopped and fed to stock on pasture. Extra cost may be offset by more efficient use of heavy stands.

stems are green and of good feeding value. As the crop ripens, the feeding value of the plant as a whole decreases, although ripe cereal crops, if properly harvested, can still be very useful feeds. Oats, barley and wheat hays are usually ranked in that order, other conditions being equal. Fall rye is good but should be harvested by early dough stage to optimize feeding value. If buying cereal hay, look for a good green color, lots of leaf material and freedom from spoilage. If the quality is good, cereal hays can make up the bulk of the forage component of the diet for beef and dairy cows, growing steers and heifer calves, and sheep. However, since the protein content will generally be less than for good quality grass-legume hays, it may be necessary to supplement the diet with additional protein, particularly for dairy cows. If lower quality cereal hays are available as the main feed supply it may be advisable to chop or grind (1/2 in. screen) the material to achieve optimum levels of intake, particularly for sheep and growing steers and heifers (It will also help to crack ripe kernels of grain, improving utilization.)

Silages

Silage can be made from almost any crop grown in western Canada. Sweet clover, brome-alfalfa, cereal crops, corn and fababeans are often used, and mixtures (oat-pea, barley-fababean, alfalfa-corn) are often used to provide a feed with a better energy:protein ratio. Properly sealed silage can be stored for several years.

Stack silo can be used to store surplus feed when conventional silos are full or not available. When properly packed and covered to exclude air, silage quality can be excellent.

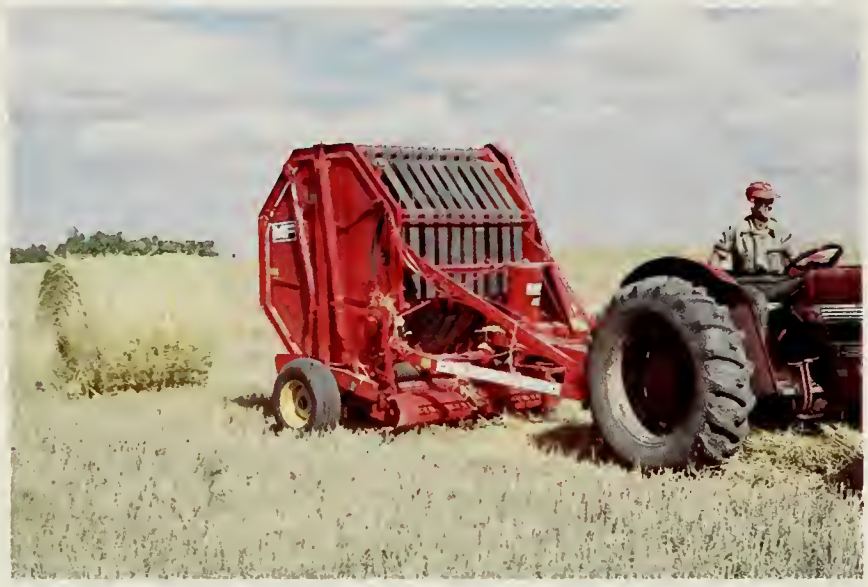
Feeding value depends on crop, stage at which crop is cut, moisture content, and proper ensiling techniques (packing, speed of operation and protection from air).

Silage at 30% dry matter can be substituted for hay of comparable quality at the ratio of 3:1. Silage is bulkier than hay and some classes of livestock may not be able to eat enough to meet their nutritional requirements when full-fed silage. However, the level of silage may have to be restricted in the case of high-producing dairy cows, pregnant ewes, growing calves and finishing steers to permit feeding of enough higher energy feeds to provide the required level of nutrients. Silage is useful in getting cattle onto feed and as part of the diet for most other classes of ruminant livestock. For further information on silage, see the Saskatchewan Department of Agriculture bulletin *Silage*, available from Animal Industry Branch, Saskatchewan Agriculture, Administration Building, Regina.

"Shorter-season" corn varieties are extending field corn growing northward from conventional growing areas. Yields of silage can be excellent but higher moisture at ensiling is often a problem in more northerly regions.

Cereal crop residues

Cereal straws are frequently used for feeding the wintering beef herd and can make up 50% or more of the diet of a pregnant beef cow. While oat straw is usually the most nutritious and palatable, barley and wheat straws can also be effectively used. Cereal straw is bulky, low in protein, has little or no vitamin A, and is low in available minerals. However, it can supply useful energy and can be treated to improve its feeding value (see "Ammoniation").



Round baling cereal straw. In times of hay shortage, cereal straw supplemented with grain, protein, minerals and vitamin A can provide a satisfactory ration for beef cattle.

Considerable variations in feeding value exist, both within and between cereal crop varieties. For example, large differences in straw of barley varieties have been observed with the feeding value of two-row barleys tending to be higher than that of six-row varieties. When feeding straw-based diets, it is imperative that the animal receive supplemental vitamin A (either by injection or in the concentrate portion of the diet), minerals (including cobalt-iodized trace mineralized salt, calcium and phosphorus) and additional protein (rapeseed meal, alfalfa hay, dehydrated alfalfa pellets, or a commercial supplement). Animals also must have free access to good-quality water at all times to reduce the possibility of rumen impaction. Grinding straw (1/2 in. screen) will permit increased intake which may be desirable when feeding sheep (since sheep don't take well to long straw) or for growing steers and heifers. However, adequate supplementation of the straw is imperative to prevent rumen impaction. Straw can be used to a limited extent in dairy diets but use should be limited to 8-10 lb/day or less.

If buying cereal straw, look for color (greener the better), leaf material, unthreshed grain kernels and freedom from weeds and spoilage. Some straws may contain sweet clover or other forage used for a companion crop; however, the forage component often deteriorates during swathing and threshing of the cereal.

Chaff is quite variable in composition, depending upon the proportions of grain and/or weed seeds present, and can range in nutritive value from somewhat better than straw to the equivalent of a low-quality hay. Chaff responds very well to ammoniation (see "Ammoniation"). Animal intake of chaff is higher than for straw since the chaff is less bulky. Chaff may be collected and stored for use as a winter feed for confined animals, or it may be left in the stubble fields as piles which the animals can use while grazing.

Supplementary protein, minerals, and vitamin A will be required when chaff is used as a major diet component.

Other crop residues

In areas where forage seed is produced it may be possible to obtain forage straw. The feeding value will depend on the kind of crop, stage of maturity at harvest, and the losses incurred during threshing. Bromegrass and crested wheatgrass straws can be quite palatable. Faba-bean residue has been found to be quite palatable and suitable as the main roughage for wintering beef cows, provided the leaf and pod material is retained in the residue. Where the product contains mostly stems, it is not palatable and must be supplemented with other feeds to increase consumption. Sunflower residue also has potential as a feed for wintering beef cows. Field pea residue may be useful but has not compared well with good wheat straw in recent tests. Where plant residues are coarse or stemmy, chopping and coarse grinding may be advisable to ensure complete consumption and avoid waste.

Grains

Barley, oats and wheat are the three grains usually considered as potential livestock feeds on the prairies, although there may be some corn available. In feeding both cattle and sheep it is important to realize that the different feed grains can be substituted readily for each other on an energy basis, but not on a weight or bushel basis. As a general working rule 5 lb oats = 4 lb barley = 3.5 lb wheat, corn or rye. Substitutions should be made on this basis.

Cereal grains also supply phosphorus and protein to the diet but protein adequacy is variable depending upon the grain used (see Appendix 1).

For cattle feeding, the grain should be broken by either grinding or rolling. With sheep there does not appear to be any advantage to processing grain. Wheat can be fed at high levels in steer-finishing diets (80-85%) provided care has been exercised in getting the animals gradually up to this level. The finishing diet should contain at least 10% ground cereal straw to provide some bulk.

FEED SUPPLEMENTATION

Farm-grown feeds almost always require supplemental vitamins and minerals and in many cases protein and energy. With any supplement, the primary considerations will be the cost and availability of the feedstuff. The following are only some of the more common feedstuffs available on the market and can be useful in meeting specific nutritional deficiencies in diets to improve animal performance. Many more feeds may be available locally. If you are not familiar with a particular feedstuff which may be available on local markets, consult a nutritionist or local district agriculturalist on its limitations or benefits before incorporating it into the diet.

Energy supplements

Feed grains Feed grains such as wheat, barley, oats and corn are excellent sources of energy and should be seriously considered as a major component of the diet. The use of grains can also eliminate the need for protein supplementation since grains are higher in protein than straw.

Tallow Add to complete diets at 2-3% to increase the energy content and reduce dustiness. Levels above 5% may interfere with rumen function. Tallow is not recommended for cold weather mixing since it will harden and bridge in the mixing equipment.

Molasses Molasses, when fed at a level of 3-5% of the diet, is useful in improving palatability of low-quality roughages. Mix with hot water (in equal amounts by volume) and sprinkle over feed at a rate of 1 lb/head/day for cattle or add to a grain or ground hay diet at a rate of up to 3% by weight. Molasses is not recommended for cold weather mixing.

Protein supplements

Commercial supplements Most commercially prepared protein supplements are formulated to contain 32% crude protein equivalent. These supplements may be available as either dry pellets or liquid. They can be economical sources of protein and contain substantial levels of some minerals. The liquid form of the 32% protein supplement may be used under feeding regimes where self-feeding may be of advantage, such as during fall grazing. However, introduce cattle gradually to liquid supplements since most contain high levels of urea or other non-protein nitrogen which can be toxic if overfed. Do not allow hungry cattle free access to liquid supplements since they may consume enough non-protein nitrogen to be toxic.

Canola meal This can be used effectively as a protein supplement, although there are some practical restrictions on its use in dairy diets.

Dehydrated alfalfa Pellets or meal are an excellent source of protein, but are often not economical to use.

Soybean meal An excellent protein source but likely costs more than canola meal.

High protein crops Ground field peas, fababeans and canola may be used as protein supplements when formulating cattle diets on the farm. The economics of using the feeds will depend on their market value relative to the more conventional protein supplements such as canola meal or soybean meal. In making the decision on whether to buy, determine the cost/percent protein of each of the feeds. For example, if a 32% protein supplement costs $320 per ton, the cost is $10 per unit of protein, whereas if a 36% protein costs $324/ton, the cost per unit of protein is only $9, making the 36% protein supplement the least expensive source.

Minerals

Salt Use a cobalt-iodized salt. It may be fed as a component (at 0.5%) of mixed diets, free choice in loose form or in combination with other minerals.

Calcium-phosphorus When feeding roughage diets, phosphorus is almost always a limiting factor. Calcium-phosphorus supplements are usually provided in a 1:1 mixture with salt. When feeding grain diets, calcium will also be limiting, requiring the addition of 1% limestone to the grain.

Trace minerals There is increasing information regarding the specific requirements of animals for trace minerals. Many trace-mineral deficiencies are area specific (i.e., selenium which is responsible for white muscle disease.). Sometimes supplementation is not only unneeded but may be undesirable (i.e., selenium which may be responsible for selenium poisoning). Although supplementation of trace minerals is generally recommended, check with local nutritionists for information about special deficiency or toxicity problems in your area.

Vitamin supplementation

The only vitamins of practical importance are vitamins A, D, and E. Vitamin A is the most important in terms of dietary supplementation. This will be particularly true during a dry period. Conception rates fall substantially each time a dry period occurs and much of this decline can be attributed to inadequate or lack of vitamin A supplementation. It is equally important that proper supplementation continue throughout the winter.

The cost of vitamin supplementation is low when we consider the potential increase in conception rate and calf crop. Several methods are available for supplementing with vitamin A. The simplest is top dressing the feed or adding it to a mixed diet. When adding to a mixed diet the level of supplementation must meet the daily requirements of the animals you are feeding. Top dressing may be done at 2-, 4-, 6-, or 8-week intervals (although 4-week intervals are generally recommended) as long as the amount of vitamin A provided meets the animals' daily requirements for that time period. For example, a cow requires about 50 000 I.U. vitamin A/day. If top dressing at 4-week intervals, the amount top dressed should be 1 400 000 I.U. per animal.

Supplementation may also be done by intramuscular injection at regular intervals (usually every 60 days). This is often not a convenient method, although it is probably one of the best since each animal definitely receives an adequate amount. Sterile procedures must be followed to minimize infection.

Another common method is supplementation of mineral or salt mixes with vitamin A. Vitamin A is unstable when mixed with minerals, particularly if the mixture gets wet. If using this method, put fresh mineral mix out at weekly intervals.

The final method of supplementation is by adding a water-miscible vitamin A to the drinking water. This method tends to be more expensive and wasteful.

POTENTIAL FEEDING PROBLEMS

With any change in the feeding management of the ruminant, problems may arise, particularly when using alternative feeds. A description of some of the more common problems follows.

Rumen impaction

When forced to subsist on unsupplemented or improperly supplemented diets based on low-quality hay or straw, cattle and sheep tend to overeat in an effort to meet nutrient requirements. The situation is aggravated during cold weather or when water intake is inadequate. Under such conditions, the digestive tract or portions of it become overloaded and feed ceases to move. This most commonly occurs in the rumen and/or the omasum, although the abomasum may also become plugged.

The problem can be largely avoided by feeding recommended levels of grain, protein supplement, minerals and vitamin A and by assuring access to a good water supply (amount and quality) at all times. In especially cold weather, extra grain or good-quality hay will help to keep the consumption of straw to a safe level. Normally the beef cow will consume up to 12 to 14 lb of cereal straw per day; this may be considered a practical limit to the amount of unprocessed straw which should be offered.

While grinding roughages for beef cows is not recommended where sufficient quantities of roughage are consumed to meet requirements, there may be a case for grinding straw in times of feed shortage, in order to increase nutrient intake without adding excessive bulk. Supplementation with adequate amounts of deficient nutrients is essential as is the provision of adequate water. Grind as coarsely as possible to assure that consumption under self-feeding conditions is not excessive. If grinding through a 1/2 in. screen to ensure minimal separation of ingredients such as grain, it is advisable to limit the amounts fed, once or twice daily, to that required to sustain the level of animal performance desired.

Nitrate poisoning

Frost, drought, weed sprays and other factors that stop plant growth can result in buildup of nitrates to toxic levels. Peak levels are usually reached about 3 days following the growth alteration. In the animal, nitrates may interfere with respiration and cause death by asphyxiation (symptom—difficulty in breathing). When high levels of N fertilizer have been used, the situation is aggravated. While deaths have occurred at nitrate levels below 1%, steers grazing oat pasture containing an excess of 2% have shown no adverse effects. Factors such as rate of intake and amount of supplemental feeding may have a bearing on the toxic level. Crops most affected by this phenomenon are cereals (particularly oats) and some of the grasses. The danger of nitrate poisoning on oat pastures is often exaggerated and may unduly deter the livestock producer from using oats for pasture. Good judgement and management must be exercised when grazing oat pastures. If in doubt, have a representative sample analyzed, remove cattle or provide additional feed on pasture to dilute nitrate level.

Oat hay should be analyzed for nitrate content if conditions at harvest time were conducive to nitrate buildup. If high levels are present the feed should be diluted with other feeds to bring the average level to less than 1%. It is also recommended that vitamin A levels be increased as high levels of nitrate interfere with carotene utilization. Where a problem is anticipated, the farmer may wish to have a treatment available. However, the treatment must be administered quickly after symptoms appear. Treatment consists of an intravenous (into the vein) injection of a 4% solution of methylene blue at the rate of 100 cc for each 100 lb body weight.

Sweetclover disease

When sweetclover hay or silage becomes moldy, a compound (dicoumarol) is formed which interferes with the ability of blood to clot. As a result, animals fed moldy sweetclover may show soft swelling beneath the skin, and may bleed excessively after an injury or operation such as dehorning, castrating, etc. To prevent this, sweetclover put up as hay should be baled at less than 20% moisture and stored under a roof or tarp to prevent moisture from entering the bale. Round or square bales left outside will likely mold if any appreciable precipitation occurs. Sweetclover silage may also mold if not properly packed to exclude oxygen or if not properly protected from air during storage.

When sweetclover poisoning is recognized in one or more animals, either discontinue feeding the forage or alternate it with a better quality hay such as alfalfa or a good grass hay. For acute cases treatment by a veterinarian (administering vitamin K or partial transfusion with blood from a healthy animal) may be necessary.

Other moldy feeds and ergot

Because of adverse weather at harvesting or during storage, forages and roughages may be put up at too high a moisture content or may be penetrated by moisture during rainy periods. This can lead to the development of mold and reduce palatability and feeding value. Horses and sheep should not be fed moldy hay, but beef cattle are rarely affected by feed that is slightly molded or spoiled. Where large amounts of molded feed are encountered this should be discarded as there is always some risk.

Moldy cereal grains have reduced palatability and feeding value but are rarely toxic to beef cattle. It may be advisable to reduce moldiness by running the affected grain through a cleaner (using a good volume of air) and/or to feed it along with other grain to dilute the product (avoid inhaling mold dust). Should animals become ill on moldy feed, call a veterinarian and replace the feed. Some high moisture grass hays, particularly in round bales, may appear to be molded but may in fact have undergone a caramelization process. This material has a sweet smell much different from moldy hay, and is quite palatable to cattle.

Grain containing ergot can cause serious problems if fed to livestock. Ergot causes muscular contractions in the uterus and intestinal tract and interferes with the circulation of the blood, particularly to the extremities (ears, tail, feet and legs). Symptoms include nervousness, muscular tremors, uncoordinated movement and convulsions. Death may result.

Grain containing ergot should not be fed to pregnant or lactating stock. For other stock the tolerance level is considered to be 0.1% ergot (1 g of ergot in 1000 g of grain, or roughly 1 ergot body in 1000 kernels of grain or about 42 ergot bodies in 1 L; a milk carton can be used to measure). It is important to obtain a representative grain sample for inspection.

Hardware disease

Livestock may inadvertently consume nails, pieces of wire and other foreign objects that may lodge in the rumen, puncture the rumen wall, or enter the body cavity or the thoracic area where they may pierce the heart or a lung and cause death. Symptoms include going off feed, stiff movement and slightly arched back, standing alone with elbows out or front feet elevated, a rise in body temperature, pneumonia and sudden death.

To avoid the problem, install powerful magnets on feed harvesting, conveying and processing equipment. This also prevents damage to the processing equipment, particularly grinders and pelleters. A magnet may also be placed in the rumen of the animal to hold foreign objects and prevent penetration of the gut. In times of feed shortages, feeds such as hay may be harvested from areas or fields not normally used for hay production (roadside ditches, sloughs, pastures, etc.) and where debris may have accumulated. Careful checking of feed from such areas would be advisable.

Awns

Cereal crops including barley, wheat and durum wheat may have awns which are irritating to the animal. Wild barley also possesses this characteristic. As well being irritable, which reduces palatability, awns may penetrate the tongue or mouth and produce absesses, lumpjaw or "wooden tongue". This may be a problem more with chaff than with straw.

Pesticide residues

Crops treated with some pesticides (both herbicides and insecticides) require a waiting period before they can be used as livestock feed. It is advisable to check with suppliers of cereal hays and straws to determine which pesticides, if any, were used in their cropping program and whether appropriate label precautions were respected. This is especially important with feed for dairy cattle, but is also significant in beef production. A few examples of precautions that should be taken:

1 Do not graze fields treated with Hoegrass for at least 21 days after application.

2 Do not use manure from animals fed straw from a crop treated with Tordon 202-C on fields used to grow sensitive crops, such as sunflowers, beans, peas, potatoes, tomatoes, alfalfa and sugar beets.

3 Do not graze or feed crops treated with Sencor, Lexone to livestock within 30 days of application.

4 Do not feed any crops treated with Mecoprop, Compitox, Mecoturf to livestock.

INCREASING THE VALUE OF FEEDS

Feeding value of roughages can be increased by chemical, physical and nutritional means. Ammoniation of cereal straws, low-quality forages and crop residues has been found to improve digestibility, nitrogen content and voluntary intake. Chopping and grinding of hay increases intake, rate of gain and feed conversion efficiency, especially when hay is of low quality. Supplementation with deficient nutrients or the use of special feed additives can also improve efficiency of feed utilization.

Ammoniation

Ammoniation of cereal straw, chaff, and a number of other crop residues has been shown to increase their digestibility, nitrogen content, and voluntary intake by ruminant animals. In many cases, large improvements in nutritional value of crop residues have occurred enabling these materials to be incorporated in diets for sheep and beef cattle at much higher levels than recommended for the untreated materials. The use of ammonia as a treatment method has been developed into a farm-scale operation by Kernan and Knipfel (1981). For producers contemplating ammoniation the following points should be considered:

Treating baled straw stacks with ammonia to increase feeding value.

1 A reaction requires a minimum time of 3 weeks during early fall when temperature is relatively high (above 10°C). Late in the year when the temperature is much lower there is uncertainty as to the length of time required and the extent of the reaction, although reaction will undoubtedly be reduced.

2 The straw should contain a minimum of 12% moisture for the reaction, although increases in nutritive value are larger at higher moisture levels. This suggests that baling should be carried out when moisture is highest, for example following a dew.

3 To carry out the process, specialized equipment is required. In particular, pressure couplers and steel pipe are needed for application of the ammonia. The availability of this equipment is limited. For plans on construction of pipes and appropriate couplers refer to Kernan and Knipfel (1981).

4 Ammonia can be hazardous to the operator unless handled by qualified personnel such as a dealer of anhydrous ammonia fertilizer.

Costs of ammoniation appear to be close to $20/ton and would provide a roughage with nutritive value close to that of medium-quality grass hay. It must be pointed out, however, that quality improvement may vary depending on the type and quality of material to be treated and the reaction conditions.

Ammoniation of chaff increases its nutritive value even more than that of straw and has the additional advantage of destroying the viability of seeds in the chaff. The economic importance of this is unclear, but may be relevant in light of present trends toward minimum tillage. Following ammoniation, chaff appears to be of sufficient nutritive value that it may support reasonable levels of growth, provided that supplementation is provided to correct mineral and vitamin deficiencies.

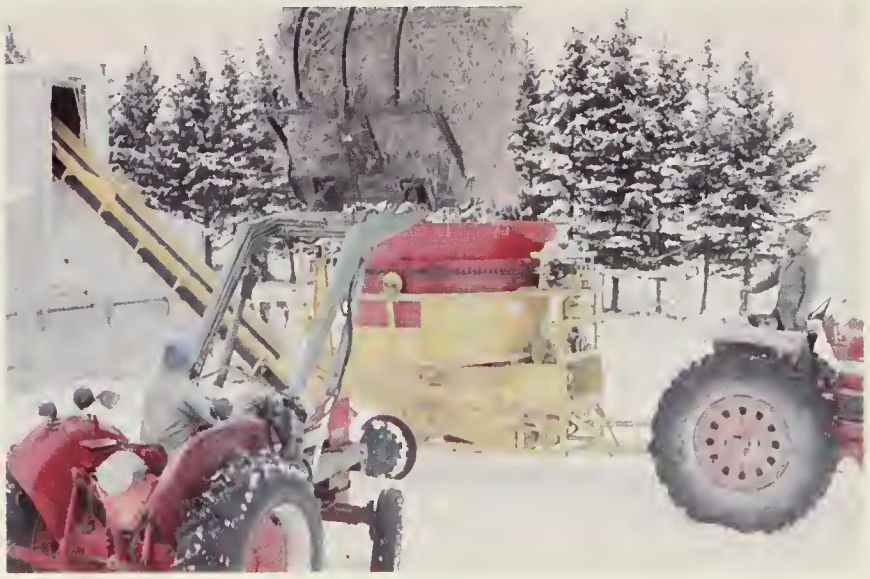
Ammoniation of high moisture (35%), high-quality alfalfa hay with 2% ammonia by weight (with the polyethylene cover left in place for 21 days) has been

found to completely inhibit molding. DE intake and daily gains of sheep were superior to that of sheep fed the low moisture control hay. This treatment may well have a place in preserving high-quality hay during unfavorable harvesting weather.

For detailed procedures for ammoniation of cereal straw refer to publication #453 of the University of Saskatchewan, which may be obtained from Mr. J. Kernan, Saskatchewan Research Council, 30 Campus Drive, Saskatoon, Saskatchewan, or from Dr. J.E. Knipfel, Research Station, Agriculture Canada, Box 1030, Swift Current, Saskatchewan, S9H 3X2.

Chopping and grinding forages and straw

When ruminant livestock cannot consume enough dry hay or roughage to meet nutritional requirements, intake can be increased by chopping or grinding as an alternative



Hay and straw can be ground with a tub-grinder to increase consumption of self-fed roughage. Supplemental feed can be fed daily as required.

to ammoniation. This may be particularly important when there is an abundant supply of roughage and grain is scarce or high priced. When roughage supply is limited it may also be necessary to ensure complete consumption of coarse stems, moldy portions, etc. Grinding prevents selective consumption. It also helps mix and thus dilute portions of the diet which by themselves are unpalatable or possibly toxic as in the case of high nitrate annual hays. Experiments have shown that grinding stemmy sweetclover hay (11.3% crude protein) through a 1/2 in. screen increased the feed intake of wintering steer calves fed an all-hay ration by 50%, doubled the rate of gain, and increased feed conversion efficiency by approximately 25%. Wintering heifer calves have been fed ground (1/2 in. screen) diets containing up to 52% ground wheat straw supplemented with grain, canola meal, minerals and vitamin A. Gains have averaged close to 1-1/2 lb per head/day over 255 days.

In general, grinding poorer quality forages produces the greatest percentage improvement in animal performance. Grinding does not in itself make the feed more nutritious; in fact, it reduces the digestibility slightly. However, grinding exposes more surface area to the action of microbial enzymes in the rumen, speeding up the rate of digestion, and thus allowing the ruminant to consume more feed. Because animals can consume more, a larger proportion of the feed intake is available for production (growth), and a smaller proportion is used for maintenance. Grinding also increases the ratio of propionic acid: acetic acid in the rumen which improves feed efficiency in beef cattle but reduces butterfat content of milk. For this reason grinding (and pelleting) of roughage is not generally recommended for dairy cattle, although part of the roughage could be so processed and used providing it is fed with some long, good-quality hay or silage.

Processing baled hay through a grinder-mixer permits proper mixing of supplements and grain and increases rate of gain, particularly for growing stock fed low-quality hay.

A ground (½ in. screen) good-quality brome alfalfa finishing ration. Grinding forage for growing-finishing steers and heifers increases rate of gain and improves feed efficiency.

Guidelines

DON'T grind forage for any class of ruminant livestock when the animal is capable of consuming amounts adequate to meet nutritional requirements. Grinding palatable diets for beef cows results in either overfeeding (wastage of feed) or the need to limit feeding (labor is wasted and cows have unsatisfied appetites), and the economics of grinding will be very doubtful.

Grind through 1/2 in. screen. Courser grinding may be all right for good-quality hay when self-fed "as is". However, in mixed rations coarser ground material will allow other diet ingredients to settle out during handling and in self feeders, and may lead to bridging in the mixer and self feeder. Finer grinding may be better for very low quality roughage but costs are too high.

Efficient grinding requires a high capacity grinder and a tractor large enough (100 hp or more) to handle it. Power requirements increase considerably as the moisture content of the hay increases. Where complete diets are to be processed, use a grinder-mixer. If forage is to be self-fed and supplementary feed hand-fed, a tub grinder may be used (If roughage is in the form of round bales, a tub grinder will have to be used).

For growing-finishing cattle, avoid diets made up of 40-60% ground alfalfa or other "bloat-prone" legume hays, fed with grain. If gradually moving from a high roughage to a grain diet, use lower quality hay or dilute with ground straw over this range. Otherwise, bloat may occur.

Consider adding tallow or other edible oil at 3% to ground forage diets to reduce dust and increase energy, depending on availability and cost.

When using high levels of poor-quality roughage in the diet, proper supplementation is essential to avoid impaction.

Since many livestock producers will be using unfamiliar feeds or diets during periods of feed shortage, they should keep a close watch over animal performance and adjust diets as necessary to meet production requirements. A livestock scale would be a real asset in checking animal performance at regular 2-week intervals.

Using supplements, additives and implants

Feeds lacking specific nutritional factors are inefficiently utilized. Making up deficiencies in energy, protein, minerals and vitamins can markedly increase rate of gain, feed conversion efficiency or milk production and enable the efficient use of low-quality feeds and crop residues. The use of growth-promoting implants (for heifers and steers destined for slaughter) normally increases rate of gain by 10% or more and improves feed efficiency under full feeding conditions on pasture or drylot. The use of additives such as monensin which alter fermentation in the rumen may increase feed efficiency but should be used under carefully controlled conditions.

LOOKING AHEAD

Unfortunately, measures to deal with drought are too often "too little, too late". People tend to have short memories once the threat is over and they become involved with more pressing problems of the moment. This is more obvious when one considers that it was only 4 years ago when the last severe drought affected the prairie beef producer.

There is a need for long-term planning to reduce the adverse effects of future drought. Experience shows that droughts of varying degrees of severity occur every few years and usually catch everyone unprepared.

While it is beyond this publication's scope to deal with long-term planning, perhaps some suggestions may be in order.

1 Aim to build up a reserve of at least 1 year's feed supply by properly storing all or part of surplus hay, straw, silage and grain. Properly cured hay will store for 2 or 3 years if placed under a roof, silage will store for several years without appreciable nutritional loss if protected from air, straw can be stored under a roof (plastic may deteriorate after a few months of wind and sun if not properly protected) and, of course, grain will keep for several years if protected from spoilage and insects.

2 Consider growing some oats or other productive annual cereal crop each year which could, in an emergency, be used to supplement perennial pastures, either by grazing or by mechanically harvesting and feeding on pasture. If not required, it could be harvested as hay, silage or as grain and straw.

3 Assess the feasibility of using irrigation. Largely because of the side effects of modern farming methods (excessive clearing of trees and bush, draining sloughs, etc.) much potentially useful water runs off agricultural lands each spring. If this could be stored and used for irrigating even a few acres of alfalfa (which could supplement diets based on cereal straw), the result could well be worth the effort, particularly in times of hay scarcity.

4 Look at methods of increasing forage production, both pasture and hay, to lengthen the productive grazing period (shorten the winter feeding period) and provide the extra feed required to build up reserves. The development of improved pastures as part of the livestock operation may increase both pasture and hay bases markedly. Effective use of commercial fertilizers and of farmyard manure could also have dramatic effects in increasing yields. Rotational grazing of pastures can be effective in increasing production. Resist the temptation to increase numbers of livestock to equal the feed supply available, otherwise there won't be any surplus for the reserve.

5 Use available feed supplies effectively at all times. Avoid wastage and consider increased emphasis on the use of crop residues and other non-conventional feeds for the wintering period. Closer cooperation between livestock and grain producers may lead to increased effectiveness for both parties. For example, livestock producers could provide a market for forages produced by grain farmers who would like to include forages in their rotations in the interest of better soil management. Manure from livestock operations could be applied on adjacent grain farms. This type of integration may show considerable promise in stabilizing both grain and livestock production.

APPENDIX 1

Composition of common feeds

Feedstuff	Dry matter (%)	Crude protein (%)	DE (Mcal/kg)	Ca (g/kg)	P (g/kg)
Hays					
Alfalfa, early bloom	90	16	2.36	14.8	2.2
Alfalfa, late bloom	90	12	2.10	13.4	2.4
Alfalfa-brome	90	12	2.28	9.5	2.1
Sainfoin, early bloom	90	14	2.40	6.4	3.1
Sainfoin, late bloom	90	10	2.25	7.6	1.6
Red clover	90	12	2.25	11.4	1.6
Sweet clover	88	16	2.50	17.7	2.6
Timothy	88	7.5	2.25	3.6	4.1
Crested wheatgrass	92	10	2.55	3.3	2.1
Slough hay	91	8.5	1.95	5.1	1.5
Sedge meadow	90	9	1.95	6.0	1.5
Oats	88	9	2.37	2.2	2.0
Silages					
Alfalfa	100	18.5	2.30	19.1	2.4
Sweet clover	100	13.5	2.20	11.8	2.2
Corn (dough stage)	100	8.5	3.00	3.7	2.2
Barley (dough stage)	100	10	2.70	3.9	2.8
Oats (dough stage)	100	9.5	2.40	4.7	3.3
Rye (dough stage)	100	11.5	2.10	4.0	2.3
Fababeans	100	13	2.49	9.0	2.8
Straws					
Barley	91	4.5	1.75	3.3	0.9
Oats	91	4	1.87	3.0	0.9
Wheat	91	3.5	1.80	1.5	0.7
Grains					
Barley	90	11.5	3.42	0.7	4.0
Corn	87	9	3.47	0.4	2.7
Oats	90	10	3.13	0.9	3.3
Rye	90	12	3.34	0.7	3.7
Wheat	90	14	3.44	0.4	4.0
Protein feeds					
Canola meal	91	35	3.26	2.0	6.6
Soybean meal	91	46	3.44	2.6	6.4
Linseed meal	91	38	3.15	4.4	8.4
Field peas	91	22.5	3.17	1.7	5.0
Miscellaneous					
Beet pulp	92	9	3.22	5.5	0.9
Beet tops	100	14	2.69	9.9	2.2
Molasses (beet)	80	8	2.65	0.4	0.2
Potatoes (DM basis)	100	9	3.59	0.4	2.3

APPENDIX 2

Daily nutrient requirements of mature beef cows

Av wt for feeding period (kg)	Daily gain (kg)	Crude protein (%)	Digestible energy (Mcal)	Ca (g)	P (g)
Dry pregnant cows—middle third of pregnancy					
350	0.0	8.0	31.2	23	23
400	0.0	8.0	14.5	24	24
450	0.0	8.0	15.9	25	25
500	0.0	8.0	17.2	26	26
550	0.0	8.0	18.4	27	27
600	0.0	8.0	19.6	28	28
650	0.0	8.0	20.9	29	29
Dry pregnant cows—last 90 days of pregnancy[1]					
350	0.4	8.0	16.1	31	31
400	0.4	8.0	17.4	32	32
450	0.4	8.0	18.8	33	33
500	0.4	8.0	21.3	35	35
600	0.4	8.0	22.6	36	36
650	0.4	8.0	23.9	37	37
Cows nursing calves of average milking ability—first 3-4 months postpartum[2]					
350		9.2	19.4	34	31
400		9.2	20.7	35	32
450		9.2	22.1	36	33
500		9.2	23.4	37	34
550		9.2	24.8	38	35
600		9.2	26.0	39	36
650		9.2	27.2	40	37
Cows nursing calves of superior milking ability—first 3-4 months postpartum[3]					
350		10.9	25.6	43	40
400		10.9	27.0	44	41
450		10.9	28.3	45	42
500		10.9	29.6	46	43
550		10.9	30.9	47	44
600		10.9	32.2	48	45
650		10.9	33.5	49	46

[1] About 0.4 +/–0.1 kg of gain per day
[2] Average milking ability = 5.0 +/–0.5 kg of milk/day
[3] Superior milking ability = 10.0 +/–0.5 kg of milk/day

Adapted from *Nutrient Requirements of Beef Cattle*. Number 4. 5th edition. Revised, U.S. National Research Council, National Academy of Sciences, Washington D.C.; 1976 and *The Nutrient Requirements of Farm Livestock*. Number 2: Ruminants, Agriculture Research Council, London, England; 1965.

Daily dietary requirements of beef heifers

Av wt for feeding period (kg)	Daily gain (kg)	Crude protein (%)	Digestible energy (Mcal)	Ca (g)	P (g)
Growing heifers					
150	0.5	11.0	11.5	16	9
	0.7	12.4	12.7	22	11
200	0.5	9.6	15.5	18	10
	0.7	10.2	16.8	24	13
250	0.5	9.5	17.3	19	12
	0.7	10.5	18.3	25	15
300	0.5	9.2	19.9	21	15
	0.7	10.1	20.9	27	17
350	0.5	8.7	22.3	24	17
	0.7	9.2	24.0	29	19
400	0.0	8.5	14.4	28	20
	0.3	8.5	22.2	31	22
	0.5	8.8	23.8	34	24
	0.7	9.0	26.5	36	26
Pregnant yearling heifers — last 3-4 months of pregnancy					
325	0.4	8.8	15.4	25	20
	0.6	8.8	19.8	27	22
	0.8	9.0	24.5	30	24
350	0.4	8.8	16.1	26	21
	0.6	8.8	20.6	28	23
	0.8	8.8	25.7	31	25
375	0.4	8.7	16.7	27	22
	0.6	8.7	21.6	30	24
	0.8	8.7	27.0	32	26
400	0.4	8.7	17.3	30	24
	0.6	8.7	22.6	32	26
	0.8	8.7	28.1	34	28
425	0.4	8.8	18.1	37	30
	0.6	8.7	23.4	41	33
	0.8	8.7	29.3	44	36

Adapted from *Nutrient Requirements of Beef Cattle*. Number 4. 5th edition. Revised, U.S. National Research Council, National Academy of Sciences, Washington D.C.; 1976 and *The Nutrient Requirements of Farm Livestock*. Number 2: Ruminants, Agriculture Research Council, London, England; 1965.